PROPOSED GUIDELINE
FOR MINIMIZING MOISTURE-RELATED PROBLEMS
IN CONCRETE FLOORS RECEIVING FINISHES

This guideline is the result of the work of the Slab Moisture Task Force and CSI Portland Chapter Specifier Share Group from March to November 2001. The participants recognized that there are structural as well as floor finish problems related to concrete slab moisture but decided to keep a specific focus on the problem of slab moisture and its detrimental effect on slab finishes. The task force also recognized that this problem was not limited to slabs-on-grade but occurred in elevated concrete floor slabs as well. This guideline, as the title indicates, does not address slabs in unheated or fully exposed environments. It also does not address basement conditions or the presence of a permanent high water table. The recommendations contained in this guideline represent a consensus—not necessarily a unanimous agreement. This guideline is intended to assist the designer and specifier in achieving reliable results through the use of economical means. It can also be helpful in educating the Owner on the issues and relative risks so that they can better evaluate the return on the cost of any additional steps they may want to implement to achieve greater "assurance" against potential moisture problems.

INTRODUCTION

The widespread occurrences of floor finish failures on concrete slabs have brought a lot of attention to their potential causes and possible remedies. Because there are numerous parties involved in slab construction and finish applications, the investigations that have been undertaken by various associations have tended to focus on specific parts of the problem. The resulting recommendations have often been limited in scope, and sometimes a proposed solution to one part of the problem has been in conflict with a proposed solution to another part. The current situation leaves the owner/design/construction team with uncertainties and may lead to either insufficient moisture protection on the one hand, or expensive and unnecessary duplication of slab moisture controls on the other.

SOURCES OF MOISTURE IN CONCRETE FLOOR SLABS

Slab moisture is present initially in the water used to make the concrete "plastic" and to start the hydration process. A slab may also absorb moisture from snow or rain, from wet construction processes or from the ground. Ground moisture can travel to the slab in liquid form through capillary movement or in vapor form that moves the moisture from one pressure zone to another.

UNDESIRABLE MOISTURE-BORN ELEMENTS

Moisture that is present in concrete slabs can also carry undesirable chemical components. Alkali (sodium carbonate) and common salts (sodium chloride) can both be present in slabs and can move through the slab via slab moisture. These components can react with floor finish adhesives and cause deterioration and loss of bond. In finished and unfinished areas, moisture born salts can cause efflorescence.

"BEST PRACTICES" TO MINIMIZE SLAB MOISTURE PROBLEMS

The basic assumption of this guideline is that moisture above a certain level is unacceptable whether or not the slab is to be covered with an attached material. Excess moisture or "tainted" moisture is undesirable in the floor finishing stage of construction as well as later during the occupied life of the building. The recommendations address the majority of conditions that exist in the contiguous United States. Special conditions may require different or greater responses and would typically be addressed in a Soils Report. **It is imperative that the Project Architect and Specifier be familiar with the analysis and the recommendations in the Report. The Soils Engineer may make recommendations different than these guidelines and it may be necessary to discuss alternatives with the Engineer. Request that the Engineer amend the Report if the design varies from the initial Report recommendations.**

There are two fundamental principles that underlie the recommendations in these guidelines:

1. The slab must be separated from ground moisture.
2. The moisture present in the slab at time of placement should be kept as low as practicable.

LEVEL 1 – BASIC DESIGN—What you should always do. (generally applies to arid zones, well-drained soils)

1. Require a minimum of 6 inches of clean crushed rock drainage course between the soil and the slab.
2. Require that the size of the crushed rock be at least 3û4 of an inch and with minimal “fines” in order to create a complete capillary break between the slab and any potential ground moisture.
3. Require that the rock be compacted per Soils Engineer’s recommendations.
4. Require the use of reinforcing bar rather than wire mesh for slab reinforcement.
5. Require concrete mix that achieves structural performance with minimal water and low alkalinity*.
6. Require curing time and conditions for optimum drying of slab. Do not use unvented propane heaters.
7. Require moisture and alkalinity tests by independent lab just prior to installation of finishes.
8. Require floor finish installer to review information on slab installation and curing, including test results, and based on this information and a visual inspection, to either accept the slab as suitable for the application of finishes or, if not acceptable, to inform the Contractor of their concerns.
   *Cement is the primary source of alkaline and one method of reducing it is to replace a portion of the cement with fly ash.

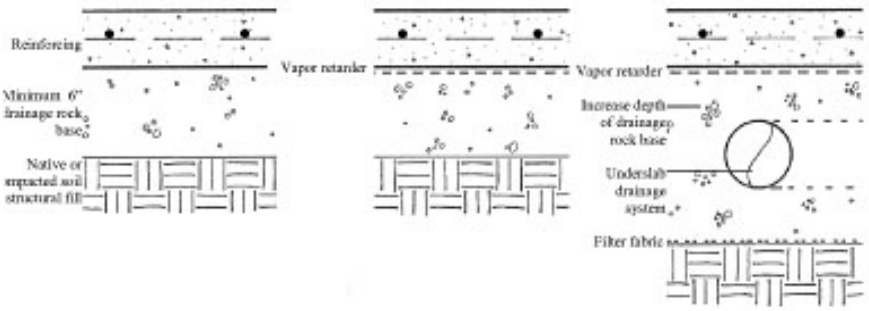
LEVEL 2 – WHEN SOIL MOISTURE IS PRESENT—When in doubt, assume it’s there.
Provide Level 1 requirements plus the following:

1. Require a “leveling course” of sand or fine-grained aggregate to create a smooth plane at the top of the drainage course to give the vapor retarder membrane good support and the slab a slip plane.
2. Require a vapor retarder of adequate composition to be placed on the crushed rock base prior to placement of reinforcing and concrete.
3. Require that the vapor retarder is repaired and reviewed for integrity prior to concrete placement.
4. Require a perimeter foundation drainage system.

LEVEL 3 – WHEN WATER TABLE MAY BE PERIODICALLY NEAR THE SURFACE
Provide Level 2 requirements plus the following:

1. Increase the depth of the rock base to accommodate the sub-slab drainage system or to a depth recommended by the Geotechnical Engineer, whichever is greater.
2. Require a sub-slab drainage system, designed by the geotechnical engineer with the review of the civil engineer.
3. Specify that a filter fabric be installed between the soil and the crushed rock base.

LEVEL 1	LEVEL 2	LEVEL 3
BASIC SLAB DESIGN	GROUND MOISTURE PRESENT	HIGH WATER TABLE



SPECIFICATIONS

01310 PROJECT MANAGEMENT AND COORDINATION

- Include slab procedures on Pre-Construction Meeting agenda
- Include Pre-Installation Conference for parties connected with slab and finishes at least 24 hours before pouring the slab
- Require that Contractor keep a log to track the slab placement procedures and conditions

01330 SUBMITTALS

- Require the submittal of the Project Log within 30 days of slab placement
- Require that completed Project Log be included in O& M Manual

01450 QUALITY REQUIREMENTS

- Include slab moisture testing (including alkalinity) in scope of work of Independent Testing Lab
- Bind in the form Project Log for Concrete Floors Receiving Finishes at end of this Section

02300 EARTHWORK

- Require on-site review of soils (by geotechnical engineer) during excavation
- Clearly define sub-slab materials as clean rock material large enough and with minimum fines to create full capillary break between slab and soil
- Require compaction per Soils Report

03300 CAST-IN-PLACE CONCRETE

- Define the testing and inspection that will be done by a Testing Lab
- Specify that a minimum of 20% of the cement be replaced with fly ash
- Require that there be no more than a .42 water-to-cement ratio, including any water added at site
- Specify reinforcing bar in lieu of wire mesh—rely on structural engineer to design reinforcing
- State acceptable environmental conditions at time of placement
- Specify curing process, list acceptable curing products, restrict propane heaters
- Specify protection of slab until curing is complete, particularly following hot and cold weather procedures

03100 FORMWORK (if separate from 03300)

- Specify vapor retarder products and procedures
    - Durable construction to withstand construction activities until concrete is placed
    - Allow no penetrations for support of reinforcing or screeding concrete
    - Follow manufacturer's instructions for installation
- Require repair of membrane prior to concrete placement
- Require "dewatering" before concrete placement
- Require site observation by Architect prior to concrete placement

DIV. 9 UNDER THE APPLICABLE FLOOR FINISH SECTIONS:

- Define the appropriate conditions for finish applications
- Require subcontractor to review the slab, the Project Log, slab moisture test results and, based on this review, to accept slab or give reasons to General Contractor for not accepting it, prior to installing finishes

ADDITIONAL NOTES

SEALERS
The specifier should coordinate the appropriate use of, and characteristics of, sealers/penetrants that may be applied to the slab prior to application of finish materials. There are some products that offer warranties against the migration of moisture from the slab to the floor finishes or building interiors. In effect these warranties shift the risks of and liability for moisture-caused flooring failures to the sealer/penetrant manufacturer. Either the flooring installer or the Owner may view this as a desirable added protection worth the added cost.

SAND OR GRAVEL ON TOP OF VAPOR RETARDER
Do not place a layer of granular material (some sources recommend sand) between the vapor barrier and the slab. This practice apparently got introduced to the industry a few years ago and has become a common recommendation of some Soils and Structural Engineers. In practice it simply creates a reservoir that collects precipitation or construction water and only adds to the slab moisture that needs to be eliminated.

End